UPDATING THE ART HISTORY CURRICULUM: INCORPORATING VIRTUAL AND AUGMENTED REALITY TECHNOLOGIES TO IMPROVE INTERACTIVITY AND ENGAGEMENT

By

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A Project Submitted in Partial Fulfillment of the Requirements

for the Degree of

Master's of Education

in

Online Innovation and Design

University of Alaska Fairbanks

May 2017

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ABSTRACT

This project investigates how the art history curricula in higher education can borrow from and incorporate emerging technologies currently being used in art museums. Many art museums are using augmented reality and virtual reality technologies to transform their visitors' experiences into experiences that are interactive and engaging. Art museums have historically offered static visitor experiences, which have been mirrored in the study of art. This project explores the current state of the art history classroom in higher education, which is historically a teacher-centered learning environment and the learning effects of that environment. The project then looks at how art museums are creating visitor-centered learning environments; specifically looking at how they are using reality technologies (virtual and augmented) to transition into digitally interactive learning environments that support various learning theories. Lastly, the project examines the learning benefits of such tools to see what could (and should) be implemented into the art history curricula at the higher education level and provides a sample section of a curriculum demonstrating what that implementation could look like. Art and art history are a crucial part of our culture and being able to successfully engage with it and learn from it enables the spread of our culture through digital means and of digital culture.

INTRODUCTION

For this project, I investigated how the art history curricula in higher education can borrow from and incorporate emerging technologies currently being used in art museums. Many art museums are using augmented reality and virtual reality technologies to transform their visitors' experiences into experiences that are interactive and engaging. Art museums have historically offered static visitor experiences, which have been mirrored in the study of art. With the increasing prevalence of technology such as mobile devices, art museums have needed to rethink their traditional methods to better engage their visitors. The digital world offers potential learning benefits such as 24/7 learning (anytime, anywhere), increased motivation and subject interest outside the classroom, more personalized learning, and real-life applicability. The benefits of incorporating such technologies also lend support to several learning theories, including constructivism, connectivism, and active learning. Constructivism is the theory that learners create their knowledge through experiences (Driscoll, 2000). Connectivism is a learning theory devised for the digital age that seeks to explain how internet technologies have created new opportunities for people to share and learn through "networks" (Fink, 2013; G. Siemens, 2006). Active learning suggests that receiving information (passive learning) needs to be combined with experiences (doing or observing) and reflection for the learning to be most effective and long-lasting (Fink, 2013).

First, I will explore the current state of the art history classroom in higher education, which is historically (and in my experience), a teacher-centered learning environment. I will also explore the learning effects in a teacher-focused (authoritative) environment. Secondly, I will look at how art museums are creating visitor-centered learning environments, specifically looking at how they are using reality technologies (virtual and augmented) to transition into digitally interactive learning environments that support the aforementioned learning theories. Then I will look at the learning benefits of such tools to see what could (and should) be implemented into the art history curricula at the higher education level and provide a sample section of a curriculum demonstrating what that implementation could look like. As a former undergraduate student of art history, I am interested in how educational technologies that are currently being used in the broader (and often more accessible) art realm can be used to improve the formal study of such.

Art and art history are a crucial part of our culture and being able to successfully engage with it and learn from it enables the spread of our culture through digital means and of digital culture.

RATIONALE

My own undergraduate art history education began ten years ago in an environment that was remarkably didactic by nature of the 'technology' utilized. I had classes that displayed images using physical slides and PowerPoint slideshows, but that was the extent of the technology used. The lectures were authoritative and the professor represented herself as the sole source of all art history knowledge. We sat in lectures, hour after hour, learning by rote the names and dates of artwork—information (not knowledge) which we would later recall on tests. The class goals were clear – we had a textbook to get through and certain historical time periods to cover. This was not an effective method of learning for every student, particularly not for those students who were not majoring in art history. When I earned my bachelor's degree in art history in 2010, technology like cell phones were commonplace. I remember sitting in a modern art history survey class in the winter of 2008 as a teaching assistant the day that actor Heath Ledger died – news that a student had found out on her phone – only for the professor to tell the student to put her phone away, as she rolled out a slide projector. What irony to be in the 21st century, studying art from the 21st century, and viewing it on technology developed in the 1700s that peaked in popularity during the 1950s. There was obviously the potential to employ the panoply of technologies available to enrich the teaching and learning experiences, and change at many levels was imminent.

Art history and technology have always been wedded if you look historically and understand technology to include concepts and processes like perspective, the camera, screen-printing, and other similar advancements. That's still true today, though less apparent in the academic study as outdated methods continue to be used to teach the subject: Microsoft PowerPoint and physical slides are two ingrained traditional methods. It is worth recognizing that slides and PowerPoint are technologies that at one point were new and novel (to art history), as reality technologies are currently. It's also worth accepting that, as the rate of technological change continues to progress, reality technologies will someday face the same outdated label as the technologies that have come before. Art history outside of academia is still heavily entwined with technology,

particularly in many teaching aspects. Today, this is readily seen in museums and art galleries around the world. How does an institution full of historically static images engage today's millennials? Is this not almost the same problem educators in academia see? How do you engage students and get them actively involved in the subject and learning process when they don't see the relevancy or intrigue in the subject? This paper looks at some examples of such marriages between art history and technology as they relate to educational purposes *outside* of the classroom. What lessons can we learn and what methods can be applied to academia? Interactivity and engagement are concepts that repeatedly came up in discussions of art museums incorporating technology and the methods used are two ways to provide the user with the most desirable experience coming into contact with the subject. Undergraduate art history educators could certainly benefit from any tools that would help captivate the attention of their classes.

Currently, two increasingly popular types of technologies that cultural institutions are experimenting with are multi-user virtual environments (or virtual reality - VR) and augmented reality (AR). For clarity's sake, a virtual environment or virtual reality is the creation of a virtual space in which users interact with virtual elements. Augmented reality is a blend of virtual reality and real life where users can interact with virtual objects in the real world. Both reality technologies place the central focus on user experience and provide greater interactivity and engagement, which contributes to long-lasting and meaningful learning. Reality technologies are also effective for bringing the subject matter to life. Clearly, technological advancements are revolutionizing the way educators teach and students learn, yet the curricula that teaches revolutionary artists and works of art (think Cezanne or the Guerilla Girls) finds itself relatively static amongst all this change. Art history needs to join the revolution; teachers need to adapt and evolve their curricula and pedagogies to benefit from many of these new technologies that facilitate better learning.

METHODS

For this project, I will suggest implementing augmented or virtual reality technologies in undergraduate art history survey courses. The sample curriculum and presentation would be delivered to higher education art history departments and specifically to those professors or graduate students teaching the introductory art history survey courses. Many of these kinds of

survey courses are taught mainly using slides and lectures, which is not typically engaging or interactive. Many students enroll in these survey courses to complete humanities or general studies core requirements, and when and when they're taught largely in lecture format, they may be less likely to feel inspired or take a genuine interest in the subject. Technology offers a way to mitigate these potential issues. There is a place in art history education for the 'art in the dark' method (teaching by showing image slides in the dark) as it will appeal to certain learning styles and has historically been an adequately effective teaching method (if done well), and there is no call to eliminate the lecture. Reality technologies should be added into the curriculum for the learning benefits they enable. Art history departments at universities are generally small, which lend them to incorporating technology. The technology is also free or inexpensive making it an easy choice for implementation.

Museums and cultural institutions have been exploring the concept of reality as a way to make art and art history more engaging by adding a third dimension to otherwise 'flat' experiences. There are two ways they've gone about experimenting with our sense of reality: virtual reality and augmented reality. In both, the space or the objects themselves become 3D and are able to be explored interactively. In the case of virtual realities, the viewer might explore a space replicating scenes from history or wander through a distant museum. Using augmented reality, a viewer may be able to see what the complete version is for pieces missing parts or may be able to 'hold' an otherwise untouchable object. All possibilities enable greater interactivity and engagement.

LITERATURE REVIEW

Current state of art history and teacher-centered learning

The academic subject of art history came into being as lectures at various art academies. The first program of known lectures was in 1594 at the Principe of the Accademia di San Luca in Rome (Witcombe, 1995). According to Witcombe (1995), these lectures were not illustrated; rather, they consisted of a specialist (often an artist member of the academy) delivering information to a passive audience, thus the "sage on the stage" was born. Little has changed regarding the method of delivery in the almost 500 years that the discipline has been developing. So little, in fact, that

the Distinguished Teaching of Art History award recipient James Cahill, stated in 2005 that "we [are] lecturers on works of visual art" (Bersson, 2006, p. 8). The only major change with regards to the modality of teaching the subject has been the addition of images to accompany lectures, including physical works of art and later slides. This is what is known as the 'Great Compromise' of art history – the willingness to accept reproductions of the original works – to enable the discipline to exist and function (Witcombe, 1995). However, the nature of the 'Great Compromise' does not extend beyond the assumption that it is best to study from original works as opposed to reproductions, because it also fails to take into consideration works of art that may never have a physical manifestation (performance art) or manifestations that undermine the physical work (environmental works of art, such as Christo's Running Fence). The 'Great Compromise' was revolutionary in allowing the study of mere reproductions and enabling a dependence on accompanying images, but is an outdated concept as the definition of a work of art continues to be fluid. In the United States, the first art history courses were taught at Harvard in 1874 and Mount Holyoke in 1878. The 1918 *Art Bulletin* cites the art history teacher at Mount Holyoke as preparing for her courses by "spen[ding] some time abroad… collecting the best photographs" (Witcombe, 1995, n.p.). These images would then be handed around during class. Read (2003) describes the experience at Smith College, before digital image banks, where students typically saw slides only in the lecture hall, and in order to review for tests, had to depend on their textbooks or go to specific locations on campus where hard copy reproductions were posted. The development of the Magic Lantern and eventually Kodachrome slides in the late 19th and early 20th centuries was revolutionary in making art accessible and the slide became a staple of the art history lecture. Donahue paints the past where "generations of art historians (have) found their calling in darkened classrooms illuminated by the glow of projected slides…" and from such a description it's not difficult to see how the popular descriptor of art history classes as 'art-in-the-dark' came to be (*Teaching art history with new technologies: Reflections and case studies*, 2008, pp. 8-9).

Professor Emeritus James Curtis of the University of Missouri (2001) observed the effect cultural norms have on teaching with slides or static images. He points out that nowadays we are inundated with images everywhere we look thanks to our media-driven society, be it on television, the internet, etc., most of which we are generally indifferent towards. Because of this,

we've effectively been conditioned to disengage from static images, which has led to "difficulty responding to art presented to [students] in a traditional slide lecture" (Gioffre, 2012, p. 16). In order to change this, art history needs to employ a model in which professors "talk to the [students], not at them" (Curtis, 2001, p. 41).

The historical approach to teaching art history has effects on the content as well, what Graham (1995) calls "the locus of professorial authority and the monologic interpretation of art, [which leads] students [to] actively create their own subjectivity as they accommodate themselves to the hierarchical cultural order that is perpetually reproduced in the typical survey of art history" (p. 31). Technology can mitigate these effects. Art history classes utilizing teacher-centered learning with the lecture-style format promotes a singular and linear viewpoint, which then drastically alters the individual students' abilities to develop worldviews and make relevant connections between the works of art and their own lives. Graham (1995) notes that the ever-more problematic fact that "the notion of the survey is tied to the authority of the panoptic gaze and the privileged perspective," harkening back to the high-brow history of the discipline (p. 33).

More often than not, art history is still taught in this 'art-in-the-dark' format. In 2006, Bersson cited that professors lectured 80% of the time and art historians assuredly lectured more than that. Hallie Scott, teaching fellow at Brooklyn College, noted that students entering the introduction to art history survey came in with dread, "fearing boring lectures and tedious memorization" (Scott, 2015, n.p.). Undergraduate students, who lack an authentic interest in the discipline, take history survey classes to fulfill generic humanities or liberal arts requirements. These introductory classes are held in large lecture halls and can have hundreds of students, which makes the talking head with images an ideal method; thus, the lecture format by and large lives up to the dread Scott described. In the current format, students don't appear to be grasping the key concepts and information necessary to meet the standards of competency, and these issues regarding lecture-based teaching have been discussed at length over the years (Doyle, 2000; Halpern, 2003). For art history, these standards of competency include employing professional terminology, being able to describe and analyze works of art, placing works in correct contexts, and being able to make connections to understand both the past world and our present one (Gioffre, 2012). Not only are students struggling with these competencies, but their

behaviors in undergraduate art history survey courses highlight other problems like a lack of engagement and low levels of participation (Gioffre, 2012). Bersson (2006) noted "too many [art historians] seem to teach to the exceptional subset of future art historians and forget or ignore the silent majority who are less than fully engaged" (p. 9).

Art history survey classes cover a vast amount of information and have depended on loaded lectures and heavy reading material to convey the necessary content. Teacher-centered learning has provided a common method to effectively communicate the information, but doesn't necessarily provide learning opportunities that are both engaging and interactive. To achieve a broader, more helpful goal in teaching students the skills to "make their own meaning of a work of art, and to understand that historical meanings exist but to not take precedence over the viewer's experience – [art history instructors] need to jettison the … lecture format" (Herz, 2014, n.p.).

Interactivity and Engagement

Interactivity and engagement in education are key components to student-centered learning and are large factors when talking about educational success. There is now considerable evidence that lecturing is an ineffective pedagogical tool for promoting conceptual understanding, a key aspect of art history (Knight, 2005). Learners at all levels gain more meaningful understanding of concepts through active engagement with information as opposed to passive listening to verbal presentations (Council, 1999). Regarding introductory classes like the survey, Knight (2005) found that "a substantial impact could be achieved if interactive and collaborative teaching were introduced" and that "such reforms may also be necessary simply to maintain enough interest among incoming students to make them want to continue as [art history] majors" (p. 305). Blasco-Arcas (2013) found that interactivity is a critical element in the learning process; it stimulates students to participate in the classroom (active collaborative learning) (Guthrie, 2004; Thalheimer, 2003), and to develop a sustained behavioral involvement in learning activities (engagement) (Carnaghan, 2007; Kay, 2009). Combined, interactivity and engagement are crucial elements to enhancing students' overall learning performance (Blasco-Arcas, 2013).

Interactivity is defined as "the ability to respond contingently to the learner's actions," (Beauchamp, 2010, pp. 759-760) and interactive teaching is defined as a "balance of directing and telling; demonstrating; explaining and illustrating; questioning and discussing; exploring and investigating; consolidating and embedding; reflecting and evaluating; and summarizing" (DfES, 2002, pp. 39-40). Higher interactivity levels correlate with greater learner control. Tanner (2005) came up with a framework to rank the levels of interactivity of teaching strategies used and the lecture method achieves the lowest level of interactivity. While lectures may be effective in communicating information to some learners when the ultimate goal is retention of low-level facts and skills (authoritative), more interactive teaching methods, such as dialog or collective reflections, provide greater learner control and are more effective in developing concepts and higher-order skills (dialogic or synergistic) (Adey, 1994; S. Kennewell, Tanner, H., Beauchamp, G., Parkinson, J., Jones, S., Norman, N., et al., 2007; Muijs, 2001). Dialogic and synergistic teaching methods utilize the highest forms of interactivity in the classroom. In these situations, students can take ownership over their learning; they can make their own decisions, open up their own dialogs, work collaboratively with others, and develop their own narratives (Beauchamp, 2010). Interactivity also leads to more effective learning and is a key component of success in education (Bannan-Ritland, 2002; Chou, 2003; Erickson, 2003; Siau, 2006). J. Liu, Hu, J., & Furutan, O. (2013) and Sims (2003) found that "when interactivity is present in the learning activity, students are not only more motivated to learn, but also more attentive, participative and more likely to exchange ideas with others" (Blasco-Arcas, 2013, p. 104).

Engagement has recently been identified as a research priority within the learning arena (Oncu, 2011). Engagement is defined as the perception of the student that results from his/her interactions with peers and teacher during the learning experience and which generates involvement with the topic studied (Anderson, 2003; Blasco-Arcas, 2013; Fredricks, 2002; Gallini, 2003). Mayer (2009) found that students learn better when they engage in the appropriate cognitive processes, thus making engagement a key variable of student success. Shernoff (2001) determined that high engagement levels are an accurate predictor of future motivation, commitment, and performance. Engagement is also a stable predictor of learner achievement (Baker, 2004; Kuh, 2003; Marks, 2000). Caldwell (2007) found that engaged students have a higher level of involvement that results in the students being more prepared,

paying more attention, taking good notes, and exhibiting improved recall of material from previous classes (Blasco-Arcas, 2013).

Technology offers ways to incorporate greater interactivity and engagement in the classroom, and has changed how teachers and students interact in the classroom (Blasco-Arcas, 2013). Simply incorporating technology into the classroom creates a student perception of some level of interactivity, which promotes active learning, collaboration, and engagement, all leading to enhanced learning performance (Blasco-Arcas, 2013). However, simply having technology in and of itself does not constitute or necessarily lead to pedagogical change (S. Kennewell, Tanner, H., Jones, S., & Beauchamp, G., 2008). Many teachers incorporate technologies into the classroom, yet still use relatively authoritative teaching methods, which does not stimulate effective learning to its fullest (Beauchamp, 2008).

Student-Centered Learning

Student-centered learning is one pedagogical solution for making art history instruction more engaging and interactive, and technology constitutes a prime means for implementing it. In an article in *Change*, Alan Guskin (1994) pointed out that "the primary learning environment for undergraduate students, the fairly passive lecture-discussion format where faculty talk and most students listen, is contrary to almost every principle of optimal settings for student learning" (Barr, 1995, pp. 13-14). The 'Learning Paradigm' that ensued sought to end the lecture's prominence and move higher education from focusing on providing instruction to producing learning (Barr, 1995). In its current state, colleges and universities are heavily instructor-centered, which works against students becoming successful learners (Weimer, 2002). In 1999 the National Research Council published a report of research on learning and made recommendations that centered on four domains, one of which was learner-centered learning environments (Froyd, 2010). One major reason for the move towards learner-centered classrooms is the skills necessary to the being competitive in the 21st century that are difficult to foster in teacher-centered environments (Kahl Jr., 2010; Skills, 2002; Yavelberg, 2014). These skills include critical thinking, creativity, and elasticity (Ackerman, 2003; Kahl Jr., 2010). The

art history survey course must clearly align its outcomes and state the skills it develops if it is to maintain its place in curricula.

Instead of the "sage on the stage" Weimer (2002) describes a student-centered classroom in which the roles change and the teacher becomes more of a "guide on the side" (Wright, 2011, p. 93). Slunt (2004) concurs that learner-centered models of content delivery allow the students to control their own learning, which forces the students to take responsibility and be actively involved in the learning process instead of passively receiving information in the lecture format. Not only that, but when students are able to take learning beyond the surface level (as often seen in teacher-centered learning) and beyond content, critical thinking can be developed. The teaching moves from simply what students think (memorization of specific content) to helping students develop how they think (critically, reflectively, etc.) (Moate, 2015). While the humanities are often disparaged for being irrelevant and producing an unmarketable workforce, they do produce quality critical thinkers and student-centered learning methods used may well contribute to that outcome.

Student or learner-centered learning approaches gained traction in the classroom after teachers found they were enjoyable, productive teaching methods. In the *Greenwood Dictionary of Education* (2003) editors Collins & O'Brien found that "properly implemented [student-centered instruction] can lead to increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught" (pp. 338-339). Writing for *Science*, Handelsman (2004) said "there is mounting evidence that supplementing or replacing lectures with active learning strategies and engaging students in discovery and scientific process improves learning and knowledge retention" (n.p.). Kahl Jr. (2010) found that "moving from teacher-centered to learner-centered instruction does not sacrifice course content or integrity" and that "fostering students' ability to apply course content successfully is a high-priority goal that may be better achieved in a learner-centered environment" (p. 185). Scott (2015), the Brooklyn College teaching fellow, gave the following review about her experiment bringing student-centered pedagogy into her art history survey course:

> Following this structure, each week I brought new approaches and activities into the ARTD1010 Art History and Its Meaning survey class that I was teaching at Brooklyn

> College, often asking my students for feedback and input along the way. I had entered the semester with trepidation about balancing content and student-centered teaching strategies, but I quickly realized that my students were engaging much more deeply with material and with the process of art historical analysis than I had ever previously experienced. This engagement occurred across the board… I think Cathy Davidson [Future Initiatives Director at CUNY] best summarized our collective experience: "You restructure your classroom with students at the center because students who are invested in their own learning, who take responsibility for their own learning, love their learning, work harder than they ever thought they would, and, in that process, you become a co-learner, not a regulator of their failure" (n. p.).

Technology has helped to disseminate the student-centered learning approach, as many technologies increase the possibility of educational choices and access to information, and provide opportunities to engage in constructing knowledge (Kang, 2015). A 2016 survey of Generation Z students (those born after millennials) found that students want "engaging, interactive learning experiences… to be empowered to make their own decisions… and expect technology to play an instrumental role in their educational experience" (Smith, 2016, n. p.). However, what students want isn't always what's pedagogically most effective. In a student-centered learning environment, teachers can incorporate interactive technologies to address this desire and expectation in a pedagogically logical way; as undergraduate art history professor Nancy Ross said about her decision to incorporate data visualization tools into the classroom, "I knew that the interactive online material would interest my students" and its use also made sense to understand the complex relationships between various artists (Ross, 2013, n. p.). There are a vast number of technologies that serve to create an engaged, interactive, learner-focused setting, which will be discussed in the next section.

Virtual Reality and Augmented Reality in Education

One type of technology that support student-centered learning and foster greater levels of engagement and interactivity is reality technology. Two particularly compelling types of reality technologies that are growing in popularity within the education sphere are virtual reality (VR) and augmented reality (AR). Virtual reality can be defined as a synthetic environment (computer-generated) that completely immerses the user's senses by simulating the physical presence of people and objects to generate realistic sensory experiences (R. Azuma, Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. , 2001; Bower, 2014; *NMC Horizon Report*

2016: Higher Education Edition, 2016). Augmented reality can be defined as an environment where virtual objects seem to coexist in the same space as the real world, thus combining or supplementing real world objects with virtual objects or superimposed information (Bacca, 2014). R. Azuma (1997) further distinguishes the two technologies by stating "AR supplements reality, rather than completely replacing it" (p. 2). While they are quite different, they do share some similarities such as flexibility and offer varying levels of immersion, and both are able to "spark similar educational outcomes, bringing learners to deeper levels of cognition as they attain new perspectives on underlying data" (*NMC Horizon Report 2016: Higher Education Edition*, 2016, p. 40). Both technologies have been introduced into the classroom to varying degrees and have shown usefulness for increasing engagement and interactivity. Each will be discussed individually in greater detail.

Virtual reality is hardly a new concept; however, its introduction into the curriculum is relatively recent, as previous barriers such as cost and accessibility have changed. There have been many variations on its definition, two of which will be mentioned here. J. Liu, Hu, J., & Furutan, O. (2013) proposed three elements to construct a virtual reality situation: immersion, interaction, and imagination (Hu, 2016). Sherman (2003) came up with four critical elements to experience virtual reality: a virtual space, immersion, sensory feedback, and interactivity (Lau, 2015). Both of these definitions include immersion and interaction or interactivity, which are key concepts to virtual reality. Immersion refers to perceiving the function of personally being on the scene or the feeling of self-location within the virtual environment (Adams, 2004; Lau, 2015; J. Liu, Hu, J., & Furutan, O., 2013). Immersion is a key part of helping students interact with representations, have better learning experience, and deepen students' learning (Green, 2003; L. F. Johnson, & Levine, A.H. , 2008; Lau, 2015; Stoerger, 2008; Wagner, 2008). One of the factors that affect the level of immersion participants experience is the environment's level of interactivity. The level of interactivity is actually one of the most important parts of the experience, even more so than the "richness and faithfulness of available images to create a feeling of presence" (Lau, 2015, p. 8?).

Virtual reality methods include computer simulation programs, avatar-based virtual realities in which you join a virtual environment as a character, projector-based virtual reality, and desktop-

based virtual reality, such as computer games. Virtual reality environments allow for students to apply, analyze, and problem-solve through a variety of learning activities that include role-play, operating simulations, designing and building things, and interacting with or creating simulations of physical or procedural processes (Antonacci, 2008). These types of activities, games, and simulations engage students in various types of higher-level cognitive thinking such as discovering, interpreting, evaluating, and learning & thinking sensitivity (Antonacci, 2008; Hu, 2016). The ability to explore information and knowledge on your own is a big factor in determining motivation and ultimately success; "the advantage of using a virtual reality to enhance students' learning experiences is not only about creating computer simulations for them to tackle real-world situations, but also creating unusual environmental stimulation to motivate them to explore new ideas" (Lau, 2015, p. 15). Using a platform where students can test out things that might otherwise be unavailable to them, such as operating on a patient, is also a benefit, but so is learning to use the technology itself. The 2016 NMC Horizon Report points out that exposure to emerging technologies will benefit students in many disciplines by preparing them for the future workplace (*NMC Horizon Report 2016: Higher Education Edition*, 2016, p. 40). All in all, virtual reality helps amplify access to information and empower students to engage in deeper learning (*NMC Horizon Report 2016: Higher Education Edition*, 2016).

Augmented reality technology has been gradually applied to various fields since 1990 and can also achieve the same purpose as virtual reality (Billinghurst, 2012; Bower, 2014; Chang, 2014; Dede, 2009; Dunleavy, 2009; L. Johnson, Adams, S., & Cummins, M., 2012; H. Kaufmann, & Schmalstieg, D., 2003; Shelton, 2002; Squire, 2007). Augmented reality has even been predicted to be the fundamental user interface of the 21st century (Bower, 2014; Kroeker, 2010). Types of augmented reality include projection-based AR, location-based AR, and superimposed AR. Unlike virtual realities, augmented reality currently requires some type of hardware to render, such as a projector, a hand-held device like a tablet, eyeglasses, or a headset, though it is not limited to any type of technology (Wu, 2013).

Liarokapis (2010) found the main advantage of augmented reality over more traditional teaching methods is that learners can actually see and listen to the supplementary information, as well as manipulate it. The ability to naturally navigate within augmented reality is another benefit of the

technology; it's easy to use, natural, intuitive, and enjoyable (Liarokapis, 2010). Wu (2013) found that augmented reality can enable: learning content in 3D perspectives, ubiquitous, collaborative and situated learning, a sense of presence, immediacy, and immersion, visualizing the otherwise invisible, and bridging formal and informal learning. Bacca (2014) found that the major advantages of using augmented reality in the classroom were increased learning gains, motivation, and student engagement, and his results corroborated those of studies done before him (Chang, 2014; Di Serio, 2013; Jara, 2011; T.-Y. Liu, & Chu, Y.-L., 2010). Augmented reality can also help students understand course content in the correct context; one that actually represents how the content may exist in the real world (*NMC Horizon Report 2016: Higher Education Edition*, 2016). Similar to virtual reality, using augmented reality had a positive effect on students' learning attitudes as their perception of the content's relevance improved (Bower, 2014; Jerry, 2010). Also similarly, Bower (2014) found students were excited that they were able to develop their own perspective and try new things. Augmented reality enables a learning experience that is both individual and personal, which highlights one of the most important functions of augmented reality – "to offer knowledge in a way that is more closely and immediately related to the world around us" (Bower, 2014, p. 12). Augmented reality addresses the issue of relevancy in a way virtual reality cannot (Bower, 2014; Jerry & Aaron, 2010; *NMC Horizon Report 2016: Higher Education Edition*, 2016).

MUSEUMS

Art museums have historically been as static as the art history discipline itself. Art was hung on walls; people could view it statically, and learn about it by reading texts or listening to a guide. Also similar to the discipline, museums recognized a need to evolve and have been successful at incorporating technology to do so. According to the National Endowment for the Arts (NEA) institution, it is absolutely essential for art museums to adapt to "shifting demographics and a rapidly changing participatory culture" (Jones, 2016, n.p.).

In fact, The Survey of Public Participation in the Arts (SPPA), which is one of the largest and most comprehensive survey of arts participation in the US, found that in 2012 about 75% of American adults used electronic media to consume art (Jones, 2016). Virtual and augmented reality technologies are a viable solution to address this need and "spark a new interest and

motivation for arts-goers" while using continuing the trend of consuming art with some form of media (Jones, 2016, n. p.). There are numerous examples of fine art museums using reality technologies to transform into more interactive learning environments that will be discussed here. Four examples of art museums using virtual reality technologies include: the British Museum (GBR), the Gemäldegalerie Dresden (GER), the Royal Museum of Fine Arts Belgium (BEL), and the Salvador Dali Museum (USA).

The British Museum was one of the first museums in the world to incorporate VR technology into its educational programming (Rae, 2016). While other early adopter cultural heritage institutions focused on the potential of VR for creating virtual tour experiences, the British Museum sought a more educational use. In 2015, the Museum's Samsung Digital Discovery Centre (SDDC) held a Virtual Reality weekend to test out how VR could work in their museum. Visitors could explore VR using Samsung Gear VR headsets, Samsung Galaxy tablets, and an immersive dome (Rae, 2016). Specifically, the Museum was interested in creating a VR experience that used 3D scans of Museum objects in their historic contexts and wanted to create something suitable for all ages. Staff chose to use the Bronze Age as the historic period for virtual exploration because it would help them to really see how much VR could enhance understanding and knowledge. Because the Bronze Age is in the distant past (third to fifth millennia B.C.), and what's known of it is based on archaeology, the general public doesn't know too much about it (Rae, 2016). This would theoretically make it easier to gauge an increase in knowledge learned from the VR tools and the exhibit. The Museum used the various VR tools to create an environment. In the case of the Samsung Gear VR headsets, the viewers were virtually transported to 3500 B.C. into a rural landscape that they could explore. They were placed in front of a Bronze Age roundhouse that had an open door and were able to 'walk' around the landscape and into the house using a touchpad. They could also move their heads to actually look around their space. Inside the roundhouse, visitors found three glowing objects scanned in 3D from the Museum's collection, which indicated they could be manipulated in some way. For those objects, viewers could take a closer view or rotate the object, all while listening to audio describing it. The experience is non-linear, there's no start or end point, so users have the freedom to explore and interact with the objects and landscape as they please (Rae, 2016). This activity was an individual one, while the activities using the full interactive

dome and the tablets made the experience accessible to a group. After the weekend, the museum surveyed 351 visitors to get feedback. About 80% of the respondents indicated the VR activities were either "Good" or "Very Good" and remarked on how fun and exciting it all was (Jones, 2016). The museum also wanted to know the value of the technology beyond entertainment and thus asked participants how much it helped them learn. One visitor remarked that they had enjoyed "exploring a cutting edge technology and at the same time learning some history," and another said that "the VR helped to feel like a more normal interaction than just seeing the items in display cases" (Rae, 2016, n.p.). Yet another visitor said the experience was a "fantastic, interactive way to learn, [I] wanted to spend more time. It really helps visualize the height and depth of [the exhibit]" (Jones, 2016, n.p.). This last comment is key as it demonstrates an experience that normal objects cannot convey and one that could be crucial to education.

The Gemäldegalerie Alte Meister (the Old Masters Picture Gallery) of the Staatliche Kunstsammlungen Dresden in Germany also experimented with virtual reality technology, although in a more traditional, less cutting-edge way than the British Museum. The Gemäldegalerie used the technology Second Life, an online virtual world, to create an online, virtual counterpart to the gallery. In 2007, the Gallery became the first virtual museum in Second Life, allowing viewers to take a tour of the museum replica and view the works of art in the real collection, just as one would in the physical space. In its first month, the virtual component had over 10,000 visitors, and while that number doesn't compare to the real-life museum's numbers (average 40,000 a month), it's an important number because it's likely reaching a different audience. Media studies professor at the Dresden University of Technology, Lutz Hagen, believes the "people using Second Life aren't the typical users of the Old Master Galleries, and the typical visitors to the Old Master Galleries aren't often on the internet, let alone in Second Life" (Curry, 2007, n.p.). Through Second Life, participants could access over 750 masterpieces that were previously only accessible by visiting the Gallery in Dresden. Virtual reality enabled the Gallery to reach a new audience. The social component to Second Life is also important; visitors can view the art, but also chat with other visitors and tour the art with another avatar in real-time ("Gemaldegalerie Alte Meister @ Second Life,"). In fact, during the Gallery's heyday, there were between 100-150 visits to the virtual museum daily and the social aspect caught on so much that a community of friends of the Gallery was established ("Gemäldegalerie Alte

Meister,"). An evaluation report from 2009 captured virtual attendance statistics and found that the 100,000 visitors since inception came from 35 different countries (Mansfield). The same evaluation also found that on average, visitors were spending 30 minutes in the Gallery, which is an extraordinary amount of time for staying in a virtual world (Mansfield). The Gallery officially closed in Second Life at the end of 2011 as the real Museum could not commit to maintaining the virtual museum.

In early 2016, the Google Cultural Institute launched a project with the Royal Museums of Fine Arts Belgium to create a digital retrospective of Pieter Bruegel the Elder's works. This project, Bruegel/Unseen Masterpieces/, was a collaborative initiative between the Google Cultural Institute and eight major international museums launched in anticipation of the 450th anniversary of Bruegel's death in 2019 (Institute, 2016; Voon, 2016). The Royal Museums of Fine Arts Belgium is the current home to many of Bruegel's masterpieces, including "The Fall of the Rebel Angels," a popular work from 1562. Because Bruegel's works are very fragile they rarely travel, and most people aren't able to access them unless they travel to the museums that house his art. Even works that were previously digitized could not do the works justice as Bruegel is known for his overwhelmingly detailed scenes that often contain tiny details one would easily miss without being able to get very close to the actual work. To that end, the initiative worked to create ultra-high resolution gigapixel images of Bruegel paintings from the nine museums to effectively create a new, online gallery dedicated to him (Caessa, 2016). The initiative did not stop with high-resolution images, however. To delve even further into Bruegel's detailed scenes, the project brought in modern technology to "supercharge the museum experience" (Caessa, 2016, n. p.). Using virtual reality, the project has created immersive spaces where Bruegel's work is brought to life and you as the viewer can literally step into it. In the case of "The Fall of the Rebel Angels" the Google Cultural Institute designed an immersive experience where you can see a

> "gold armor-adorned St. Michael expel the devil from paradise, [be] surrounded by the flapping wings of angels transformed into demons, of butterflies, and of hybrid monsters… Above you, a swarm of beasts appears to spiral from the white heavens; below lies a murky darkness just visible past the crowds of waving limbs, claws, and tails"(Voon, 2016, n.p.).

This experience is viewable on YouTube without any devices, but is intended to be viewed using VR glasses, like Google Cardboard. The Royal Museums of Fine Arts Belgium also hosted an immersive 'Bruegel Box' where renderings of three iconic Bruegel images were projected onto the walls, allowing visitors to walk in and find themselves quite literally in Bruegel's pictures (Caessa, 2016). These experiences "aim to stimulate the interest of every member of the public, inviting them to (re)discover the works with their own eyes" (Institute, 2016, n.p.). The initiative also placed similar immersive experiences at other museums in the collaborative. Virtual reality opens a new dialogue between visitors and the artwork and makes accessible artwork that may not last the test of time. The booklet explaining the project states "the advent of digital technologies has had a profound impact on the context in which museums operate and evolve, changing the visitor's relationship with the institution and the work… Everyone has the opportunity to be surprised, inspired and appreciate the artist's genius…" which is invaluable (Institute, 2016, n. p.).

In early 2016 the Salvador Dali Museum in St. Petersburg, Florida, created an interactive painting using virtual reality as part of an exhibit that explored Dali's friendship and creative partnership with Walt Disney called "Disney and Dali: Architects of the Imagination" (Blakemore, 2016). Dali, a Surrealist master, was known for his explorations into the human psyche, creating landscapes that seem dream-like and blur the line of consciousness. To create a surreal experience for visitors that went beyond looking at the paintings, the museum created an immersive 3D environment using Oculus Rift headsets. They called this experience 'Dreams of Dali.' The experience enables viewers to step inside Dali's 1935 dreamscape painting *Archeological Reminiscence of Millet's Angelus*, which is based on a work by Jean-Francois Millet of two peasants in a field praying over a basket of potatoes. Dali said that he saw that image as a child and was haunted by it and that it "produced in me an obscure anguish, so poignant that the memory of those two motionless silhouettes pursued me for several years with the constant uneasiness provoked by their continual and ambiguous presence"(Dali, 2013, p. 64). Dali's painting reimagines Millet's and contains two similar figures (depictions of Dali as a child) that are looking up at two huge stone monoliths. 'Dreams of Dali' allows viewers to step into this 360-degree landscape through their VR headsets and move around, having access to the Dali's imagination (Kleiman, 2016). The director of the Dali museums stated that through the

VR experience, "you can look beyond the areas depicted on the canvas, explore the elements of the painting and other works. For example, you can get to know other famous elements of Dali's work-such as his often-recurring elephants, birds and ants. Further, you can listen to what could have been the artist's thoughts in his own voice" (Kleiman, 2016, n. p.). While the viewer isn't in total control of the experience, he or she is free to look any direction he or she chooses. But it's not only about stepping into the painting – "rather, the painting is a jumping off point, a metaphorical springboard into a digital walkabout that its creators hope feels like traipsing around Dali's imagination" (Rhodes, 2016, n. p.). For those who were not able to make it to Florida to see the exhibit, it was also made accessible online through YouTube, and the virtual reality aspect could be experienced using simpler VR tools like Google Cardboard. This VR experience won international recognition and many industry awards, but more importantly it was well received by its viewers (T. D. Museum, 2017). The YouTube component itself has well over a million views in the year it has been available online and the comments section show that people really like the experience. Comments include remarks like "Truly amazing! It has forever changed the way I will look at the art of Dali," "My heart is pounding out of my chest! What an experience! I am not afraid of heights in real life but this actually played with my emotions... I LOVE IT!" "I congratulate the creators. Brilliant. Seeing you floating in what could be your life, and detached from time," and "Dali would be gobsmacked!" (Museum, 2016, n. p.).

Augmented reality has been implemented in museums more often than virtual reality technologies because it can make use of technology already in the visitor's hands: mobile devices. We live in a digital age and people are more than accustomed to holding up their mobile devices to take pictures, therefore holding up their devices to scan an AR object more easily fits into the museum experience (Ding, 2016). To put it more eloquently, "AR tools offer users the possibility to deploy their phones as pocket-sized screens through which surrounding spaces become the stage for endless extra layers" (Schavemaker, 2011, n. p.). It's also rather cheap. Some museums are creating their own AR apps, but the majority are utilizing free AR apps such as Layar. Museums' use of augmented technologies was so predictable that in 2002, media guru Lev Manovich claimed that:

> Having stepped outside the picture frame into the white cube walls, floor, and the whole space, artists and curators should feel at home taking yet another step: treating this space

> as layers of data. This does not mean that the physical space becomes irrelevant; on the contrary… it is through the interaction of the physical space and the data that some of the most amazing art of our time is being created. (Schavemaker, 2011, n. p.).

This is one advantage over virtual reality in which the technology and tools required come with a large price tag. According to the 2012 Mobile in Museums Study, 1% of museums in the United States have embarked on AR as a mobile feature (Analytics, 2012). A more recent statistic was not available. Four examples of using augmented reality technologies include: the Van Gogh Museum in the Netherlands (NED), the Asian Art Museum in San Francisco, the Cantor Arts Center at Stanford University, and the Metropolitan Museum of Art.

The Van Gogh Museum (VGM) in the Netherlands is a prime example of the capabilities of augmented reality in a museum setting. The goal of the VGM is to "make the life and work of Vincent van Gogh and the art of his time accessible to as many people as possible in order to enrich and inspire them" (V. G. Museum, 2017, n.p.). In order to best achieve their mission they look for a balance between content, context, and the users who visit the museum (De Vet, 2014). What they found is that traditional educational tools, like wall text or short videos, were insufficiently engaging the public. They turned to augmented reality technology for a more inspiring method of engagement, one that could be more effective because it can be adapted to the learning styles, motivations, and prior knowledge of the users (De Vet, 2014). Prior to implementing the augmented reality technology in an actual exhibit, the museum performed hands-on tests with the digital tools to gauge their success. The survey showed that "touching and discovering" was an easy format to use and "⅔ of the participants said iPads added value to the museum experience, they were fun, refreshing, and surprising" (De Vet, 2014, n. p.). The museum staff then developed prototypes to test through qualitative sampling and found a high number of people clicked through the tools for more information. This led to key takeaways when designing their final tool: content needed to lead the way, the link between interaction and the context was crucial to the experience, and the layered structure of doing and discovering, basic explanation, followed by in-depth exploration was the most successful structure (De Vet, 2014). Structure aside, ultimately the museum staff wanted the new tools to use methods familiar to their audience, be inviting and intuitive and easy to use, engage more senses than simply sight, playfully encourage in-depth exploration, and invite dialogue and interaction between patrons.

They ended up creating four tools, three of which utilized augmented reality: the "Touch Van Gogh" app, high-tech 3D prints (Relievos), and a perspective frame with drawing app. Museum staff found all three well-received. Regarding the "Touch Van Gogh" app, a Dutch lifestyle news site commented, "through playful exploration, you get to know the Dutch painter, learning by doing… information is very detailed, and because everything is touch-controlled, the app is very pleasant to use" (Bright, 2013, n. p.). The Relievos technology is a printing technique that allows replication of color and the surface texture of a painting (De Vet, 2014). Two sections of these Relievos prints were placed near their original Van Gogh paintings so viewers could actually feel the contrast between Van Gogh's famous thick brushstrokes and more thinly applied paint and get a better understanding of his materials and how he used them. The perspective frame and accompanying drawing App let viewers draw a landscape on a touchscreen that utilized the perspective frame. This showed users that Van Gogh didn't rely on talent alone, but rather he developed his skills through practice. The museum found this component to be extremely popular and found that something that previously had to be explained through text was much better understood when viewers could use the perspective frame themselves (De Vet, 2014). The museum also found that the familiarity of touchscreens helped to motivate their visitors to use these tech tools, because once they saw the touchscreens, they naturally wanted to touch them. Visitors were then motivated to explore the tools and thus the exhibit content (De Vet, 2014).

In February 2013, the Asian Art Museum (AAM) in San Francisco introduced its new iOS application in its exhibition *China's Terracotta Warriors* using augmented reality in the hopes that "visitors find it will enhance their experience" (Yeung, 2013, n. p.). The exhibition features ten life-size terracotta figures along with a number of rare objects that were found in underground sites that surround Qin Shihuang's (China's First Emperor), tomb. The actual 'Terracotta Army' that exists in China is comprised of over 9,000 life-size sculptural pieces, a scale that would be nearly impossible to recreate in a museum setting. The AAM created an app that would "give visitors an additional fun interactive layer to their exhibition experience" by viewing virtual objects at various angles in a real environment (projecting the images onto real space aka 'bringing them to life'), taking pictures, and sharing that content to Facebook (Yeung, 2013, n. p.). The app made use of the camera feature to display content that has trigger points

throughout the exhibit. The trigger points were seven placards placed throughout three exhibition rooms that, when scanned, displayed videos and 3D content (Yeung, 2013). While the museum visitor who reviewed the app came away with mixed feelings, having cited flaws and quirks that include Wi-Fi connectivity and the tradition of silencing your phone when in a museum which works against the app that plays videos with noise, there are two key takeaways from the AAM's experience. First, the museum decided to include an app feature that allowed patrons to take photographs and share them to Facebook. This adds a social aspect to the exhibit and speaks to the connectedness of today's world. Patrons can share their excitement, new knowledge, disappointments, frustrations, etc. with an unlimited audience. I'm unsure if there were hashtags or anything of the sort making the Facebook images discoverable and linked to each other and the museum, but even if there weren't, the social activity recognizes an implicit desire to share and connect with others. Second, the museum recognized the importance of meeting their patrons where they already were: on their mobile devices. In an article from *Smithsonian Magazine*, author Randy Rieland states that:

> Those who run museums know that the people walking around their buildings are already spending an inordinate amount of time using their phones, whether it's taking pictures or texting friends or taking pictures to text to friends. So it only makes sense to find ways to turn phones into storytelling tools that can bring the inanimate to life. Or shift time. Or add layers of knowledge. More museums are taking the leap and while the results can sometimes still seem a bit gimmicky, it's a move in the right direction. (Rieland, 2012, n. p.).

Stanford University also experimented with augmented reality to enhance the in-gallery experience by creating Art++, an interactive technology in play at the Cantor Arts Center meant to teach viewers about the various works of art in the exhibit. The exhibit went live in the summer of 2016 and included nine works that spanned 400 years, ranging from 1600-2000. The exhibit used a tablet in the gallery that was able to recognize any work in the exhibit and provide extra information. This information could be up to four pages worth and could also include photographs or videos of the restoration process, real life locations, or small symbolic details (Ketcham, 2016). One example is one of Andy Warhol's Mao paintings. If the viewer looks at it through the app on the tablet, he or she can see all the other iterations in the series side-by-side.

The Art++ website claims that it "Art++ is a new augmented reality application that enriches and enlivens the in-gallery experience for museum visitors. Developed in collaboration between Stanford graduate students and Cantor Arts Center staff, Art++ immerses visitors in the history, context, and importance of selected artworks by overlaying relevant content on the tablet viewfinder. Overlay highlights include historic photos and 360 panoramas that visitors can explore. The learning experience is interactive and self-guided, encouraging visitors to look at art in new and unexpected ways" (University, 2016, n. p.). The head of the Art++ program at Cantor, Maricarmen Barrios, describes it as an "interpretation tool" meant specifically for museums. "It was developed in collaboration between engineering graduate students here at Stanford interested in research into augmented reality, and with Cantor staff. The point of it is to have visitors understand the history, context, and art historical importance behind the artwork" (Furino, 2016, n. p.). Providing context isn't the only success/goal of the program; it's also potentially increasing engagement, at least in the sense of time spent. Barrios found, through observation, that the median amount of time people spend in front of a famous work of art is 10-12 seconds. At Cantor, she found those using Art++ were spending almost on a minute on works that were not famous (Furino, 2016). One final takeaway from Stanford's experimental use of augmented reality is their awareness that experiments are okay and art museums are a great place for such experimentation. Barrios stated that the job of museum educators "is to inform the public about what they're seeing, and to give them the skills to better understand art on their own" which holds equally true for educators of art history in an academic setting (Furino, 2016, n. p.).

In 2011, the Met made the (at the time) rather shocking decision to openly allow cell phones, removing the signage that asked visitors to store their devices. Embracing the technology that was becoming ubiquitous allowed for their gradual exploration into technology and the museum. As early as 2013, the Met began exploring augmented reality technologies. Don Undeen, then manager of the Met's Media Lab, explained his thoughts about incorporating AR: "the idea that you can use your iPad like a 'magic window' — seeing for example the x-ray of a painting when you hold your device up to the real thing, is compelling to me. AR applications can help people see our objects in their original context, or how they were originally used, which helps fulfill our educational mission" (Ziamou, 2013, n. p.). In 2014, they began to play around with a prototype

using the iPad that would allow viewers to interact with the algorithmic designs in Islamic tiles. Because a large portion of the Met's collection of tiles was just single tiles or incomplete fragments, it was hard for people to visualize the tiles covering complete spaces, as they would have in their original settings. Two interns devised an app using augmented reality that brought in a participatory element for viewers using algorithms. The app utilized mobile device camera technology to use object recognition to recognize the tiles in the Met collection and bring up the algorithmic equation used for that particular tile, allowing the viewer to then change those values and create new 'tiles' of their own (La Duca, 2016; Wever, 2014). While this prototype does not appear to have ever been displayed, the two creators stated the importance of incorporating this kind of participatory element in the museum experience was a way to not only enhance that experience, but also to "creat[e] new avenues for visitors of all ages that are both fun and educational… [and create] direct contact with the Met's extensive collection" (Wever, 2014, n. p.).

In 2016, the Met incorporated augmented reality technology from the MediaLab in collaboration with the Department of Egyptian Art. They used a form of spatial augmented reality technology called projection mapping to bring to life an ancient Egyptian temple – the Temple of Dendur. Projection mapping is a technology that can turn physical objects and buildings into a surface for projected light. The MediaLab created a tool called "Color the Temple" that projected light to digitally restore the Temple's original colors. The staff that created the tool wasn't satisfied with a simple projection of the digital recreation; they wanted to incorporate some level of interactivity so they developed animations that emphasized certain elements and storytelling (Felsen, 2015). Storytelling animations helped bring scenes that were on the original temple to life. Animations also helped explain the 'flat' figures in Egyptian art that actually represents 3D scenes. A visitor to the exhibit "said that he might have heard before that Egyptian temples were painted, but he was surprised by how rich and fresh the colors appeared in person. 'You feel closer to the creators… it's not just dead stone'" (Barone, 2016, p. C2). The tool was well received and "opened up new avenues of inquiry, brought about new ways of thinking, and made [the museum] look for answers outside of traditional research methods" (Felsen, 2015, n. p.).

COMPONENTS OF IMPROVED EDUCATIONAL EXPERIENCES

All of the museum examples above share certain components that have direct correlations to learning benefits and certain learning theories. All of the individual characteristics of the museums' use of AR and VR (e.g. inviting personal discovery, improving accessibility, playful exploration, etc.) can be grouped into four major categories that support an improved educational experience: personal learning, a social component, the use of technology, and interaction. This section will look at what compromises those major categories and what the pedagogical benefits are for each.

Personal learning has many more objective characteristics that can be identified as well as some more subjective characteristics that were found in the museum examples that are more specific to art history. The more objective aspects of personal learning include a lack of linearity, self-guided or self-controlled, 24/7 access, and adaptability to learning styles, motivations, or prior knowledge of the user. Subjective characteristics garnered from the museum examples include learning that brings the user into direct contact with the art, invites personal discovery, enables a personal relationship to the artwork, evokes an emotional response or connection, and allows the user to reinvent his or her perceptions.

The amount of control users have in educational experiences is an important factor in learning and a large part of constructivist learning pedagogy. Reality technology tools are excellent at providing scaffolding for learning while allowing and encouraging somewhat unmediated experiences. Through these tools, "information can be made available to students at the exact time and place of need… [which] has the potential to reduce cognitive overload by providing students with 'perfectly situated scaffolding'" (Bower, 2014, p. 1). With the proper structure set up, unmediated experiences can occur 24/7. Hoffman (1996) found that in rich-mediated environments, when users can control the flow of information interacting with a product, users consider the item as unmediated, allowing them to react directly to the items as if they were physically present. This process augments users' cognitive ability to integrate, retain, and understand the information presented (Katz, 2015). Immersive environments, and particularly augmented reality technologies are "primarily aligned with situated and constructivist learning theory, as [they] position the learner within a real-world physical and social context while

guiding, scaffolding and facilitating participatory and metacognitive learning processes such as authentic inquiry, active observation, peer coaching, reciprocal teaching and legitimate peripheral participation with multiple modes of representation" (Dunleavy, 2009, p. 1). When a student can virtually enter a Dali painting and choose to go left, right, down, up, that student is creating his or her own discovery activity that encourages diverse thinking and problem representations (Lee, 2010). Not only that, but that immediacy of control plays a significant role in influencing the interaction and learning experience. One of the main advantages of this interaction is that users are able to approach objects or settings from multiple perspectives, which stimulates their creativity. In the case of the Dali example, students could venture into the painting to get the perspective of the artist in addition to their own, which could help students personalize works they may have found irrelevant (Dede, 1996; Lee, 2010). This kind of experience through reality tools also enables students to make deep and lasting connections within their knowledge base (Kerawalla, 2006). Control is also an important factor in motivation. Kinzie (1988) found that control is relevant since students learn through making instructional choices and feel more motivated to learn, which leads to better performance. Lepper (1985) found that control has a direct correlation to students feeling competent, self-determined, and intrinsically more interested in learning. One might think of motivation as a subjective factor that cannot be changed by the tools used. However, this kind of educational motivation is not attached to one's external interest in the subject matter, but rather is based on what intrinsically pushes a student to learn. Rost (2010) describes motivation as "provid[ing] a source of energy that is responsible for why learners decide to make an effort, how long they are willing to sustain an activity, how hard they are going to pursue it, and how connected they feel to the activity" (in Di Serio, 2012, p. 1). Di Serio (2013) found that incorporating AR into the learning environment led to clear improvement in attention and satisfaction motivation factors when compared to a more traditional learning environment. If museums can tap into technology as a way to encourage and increase users' motivation, they can potentially create a better, more effective learning experience.

Many of the museum examples had a social component that carried with it learning benefits for the visitor. Examples of social components include creating a shared group experience, sharing content, or anything to create a social dialog, no matter the scope. These elements of a social

component fall into the broader learning theory of connectivism, which will be discussed further in this section with regards to its benefits.

According to Cobb (2010) one of the most important purposes of an educational environment is to promote social interaction. While traditional art museums can create social interaction through dialog and interactive activities, many are making use of technological tools such as AR and VR to create a new kind of social interaction. The Asian Art Museum in San Francisco, for example, incorporated an app feature in their exhibit on the Chinese Terracotta Warriors that allowed visitors to take photographs and then share them to Facebook. On one hand, people are likely doing this anyways as it has become the norm to share so much of one's personal life on the internet. On the other, by encouraging this sharing on social media platforms, the museum not only recognizes this human desire to share and connect with others, but it can open up a dialogue well beyond the confines of the museum walls. People a hemisphere away can connect to an exhibit through Facebook photos or Twitter hashtags, which have a more inherently social feel. Other museums, like the Gemaldegalerie Dresden, are creating social interaction through shared virtual learning environments (VLEs). The gallery in Second Life allows visitors (avatars) to view the art and also chat with other avatars or tour the art with another avatar all in real-time. As previously mentioned, the social interaction in Second Life became so popular that a separate community of friends of the Gallery was created. This kind of technology can help facilitate learning through collaboration and interaction, as people in different physical locations are able to share a common VLE and thus a common experience (H. Kaufmann, 2003). The social media components mixed with collaborative or shared experiences support the learning theory of connectivism. Connectivism, as a theory, explains how internet technologies have created new opportunities for people to share information and learn, specifically through the Web and amongst ourselves (krista2366, 2015). It's a learning theory devised for the digital age as it speaks to all the ways learning can take place online and outside of the classroom, and the community that can develop as a result. We live in an extremely networked world, one in which "learning is the process of connecting, growing, and navigating those networks" (G. Siemens, & Tittenberger, P., 2009, p. 11). According to a 2011 study from Global Faces and Networked Places, among the entire population who uses the internet in the world, "75% is the member of social networking sites (sic)," which means that there's an infinite number of opportunities for

people to connect with new people, new information, and new networks on those social networking sites (Tinmaz, 2012, p. 235). In the case of the Chinese Terracotta Warrior exhibit incorporating Facebook, visitors to the exhibit were able to share their experience and knowledge with others who may or may not have experienced the exhibit, but who may have had other stakes in that information. Facebook "provides a well-established platform for creating connections among users who have different knowledge levels on any topic" (Tracey, 2009, pp. 8-9) and "creates opportunities for establishing new contacts and joining to different networks and communities" that otherwise may not have existed (Tinmaz, 2012, p. 240). Visitors to the Asian Art Museum in SF could find new communities of people who were interested in Chinese history, Chinese art, art history in general, the Asian Art Museum, etc. through social networking sites and develop connections that could ultimately help enrich their own knowledge, skills, and abilities (Tinmaz, 2012).

All of the museum examples utilized technology to support their educational goals. Characteristics specific to the AR and VR technologies utilized include that they are cutting edge, they improve accessibility, they are multi-sensory, many of them meet the users where they already are, they are motivational, they build on human nature, and they enable deployment of personal devices. It is important to distinguish between the technologies themselves and the use of those technologies when talking about the effect they have on the overall educational experience. In all instances discussed, it is the implementation and the *use* of technologies that contribute to perception, relevancy, and motivation, not merely the implementation of the tools themselves.

Art and particularly art history could also benefit from the findings of Jerry (2010) who found that the use of technology has a positive effect on some students' learning attitudes and contributes to their perception of the relevance of their learning to their everyday lives. There's something to be said for looking the part. Museums that experiment with and incorporate cutting edge technologies portray a perception that they are current, relevant to the times. Even if the technology use isn't perfect, there is still a general recognition that museums are trying to incorporate more modern tools to attract new (more) visitors. Art history could certainly benefit from that kind of shift in how it is perceived as the subject matter (and often art itself) struggles

with being irrelevant and married to outdated technologies such as PowerPoint. More technically, technology use can provide benefits beyond perception. Technology use improves motivation. Katz (2015) found that 3D technology use improves representation displays, which motivates the users to explore deeper into the subject matter while McLellan (2004) concluded that features of virtual environments that encourage action and exploration such as 3D dimension, dynamic display, and closed-loop interaction have a similar effect on that motivation. AR and VR technologies can be quite simple in the art history realm; for example, in the Bronze Age exhibit viewers could look at and interact with objects in the roundhouse. They could zoom in on the object for a closer examination or rotate it to look at all sides and get a better idea of how the physical object would exist in 3D space all while listening to audio about the object. These rich perceptual cues and multimodal feedback created a realistic environment, which enabled learners to be more motivated and engaged with the material, "thereby cognitively processing the presented material more deeply" (Katz, 2015, p. 786; Lau, 2015, p. 5). Another aspect of technology these examples demonstrated is that of meeting visitors where they already are. We are almost all familiar with personal communication devices like mobile phones or tablets. In de Vet's discussion of the Van Gogh Museum experience for MW2014, she cited studies showing that "79 percent of museum visitors use smartphones (Apple products are popular), and 27 percent check social media in the museum using Wi-Fi (Klooster & Vlek, 2012)" (De Vet, 2014, n. p.). There is a tendency to gravitate towards the familiar, so when visitors see touchscreens in the museums, they almost automatically want to touch them (De Vet, 2014). This encourages engagement and acts as a motivation to explore. Also in the case of the Van Gogh museum, visitors were able to deploy their personal devices, thus building on this shared human experience of technology use.

Lastly, interaction plays a huge role in supporting learning and the museums incorporated many interactive characteristics that were fun, immersive, inspired engagement, or encouraged playful exploration. All of the interactive components support an active learning environment, which will be discussed as it pertains to the museum examples.

Interaction is also crucial in enriching knowledge and supporting more inspired and effective learning. In fact, interactivity is one of the critical elements in the learning process; it motivates

students to participate (active collaborative learning) and to develop a long-term involvement in the learning activities (engagement) (Carnaghan, 2007; Guthrie, 2004). These two elements, active learning and engagement, are instrumental in enhancing learning performance (Blasco-Arcas, 2013). Blasco-Arcas (2013) found that "when interactivity is present in the learning activity, students are not only more motivated to learn, but also more attentive, participative and more likely to exchange ideas with others" (p. 104). The museum examples discussed incorporate interaction in a variety of ways. Stanford's Art++ program used a tablet running AR software that brought up contextual overlays at the visitor's touch of a button. This encouraged exploration and self-discovery. Katz (2015) found that when visitors (users/students) take this kind of active role in learning environments, they may enhance their reasoning process and become more motivated to know more about the exhibits. This was supported in the program's observational findings that use of the program increased engagement, at least in terms of time spent observing each work of art. Interactivity is also associated with vividness, which the Met relied on to bring the Temple of Dendur to life (Fortin, 2005). By using technology to restore the Temple's original colors and adding storytelling animations, visitors were able to engage more with the content. Wu found that "the vividness with which a message communicates interaction increases its persuasive power, generates in users more cognitive elaboration of the central arguments and increases the user's memory of relevant information" (Blasco-Arcas, 2013, p. 778). Being able to interact with artworks and art objects themselves was mentioned previously as it related to technology, but also comes into play as it contributes to sensory immersion. The Royal Museums of Fine Arts Belgium created a completely immersive experience that allowed visitors to step into Bruegel's "The Fall of the Rebel Angels" painting, the Dali Museum did the same with *Dreams of Dali*, as did the British Museum with the Bronze Age Roundhouse; these immersive experiences incorporated multiple senses (sound, sight, ability to 'touch') and this kind of experience has been found to "increase student interest, understanding, and creative learning" (Katz, 2015, p. 778). The freedom to explore and play in a non-linear complete environment highlights the importance of creative interactions. Creativity is ultimately profound fun, as some research shows, and fun is an "essential driving force for being explorative in education" (Lau, 2015, p. 15). Beyond fun, interactivity done through engaging augmentation is both attractive and motivating to today's generation of media-conscious visitors and students (Liarokapis, 2010).

VR & AR IN THE ART HISTORY CLASSROOM

Art history professors have been slowly changing the perception of art history by keeping these keywords in mind as they revamp curriculums and teaching strategies. Examples of such progress is seen in a 2016 Renaissance art history class at Dixie State College of Utah, where Dr. Nancy Ross used Pinterest and then a collaborative activity to support technology use, interaction, and engagement. Her students found images to pin to a class group Pinterest board, which became their raw data, and then the class used that data to creative timelines showing when black magi were incorporated in painting and stained glass (Ross, 2016). These two activities encouraged active learning and helped students see the larger frame of art history, beyond the study of individual works of art. In 2016, Adjunct Lecturer of Art History M. Stephanie Chancy of Florida International University used 3D printing to produce a replica of the Venus of Willendorf, a statue carved 25,000 years ago. Students are now able to closely observe the details, the size, the decorative elements, etc. that they might otherwise be unable to observe in an image in a book or even a high-quality digital image projected on a screen. Chancy characterized the value of the replica further in her statement that "understanding an artwork's context and function is enhanced when you can look at it from every angle and see everything" (Brizuela, 2016, n. p.).

Although art history classrooms are showing pedagogical progress, the successes seen in the art history museums' use of virtual and augmented reality technologies have not spurred a proportional amount of exploration into incorporating those technologies in the classroom. This section includes a sample of curriculum for a generic undergraduate level art history survey course that utilizes AR/VR technologies. It is pertinent to remember that while AR/VR technologies do offer many learning benefits, they are just tools and their inclusion in a curriculum needs to be suitably justified. No tools should be incorporated just because they're new, 'cool,' or different. The tools need to support the learning objectives of the course while adding relevant learning benefits. Earlier sections pointed out many of the issues plaguing undergraduate art history courses, including engagement and interactivity; reality technologies are one way to improve these issues, however they should not be considered in isolation or as complete solutions in and of themselves.

To demonstrate potential appropriate use of AR and VR tools in art history, I have drafted a two-week lesson plan as a part of a curriculum for an undergraduate art history survey course: Art History 200x: Visual Culture in Western Europe in the 19th Century. This is a typical art history survey course that would be offered at a university and would meet twice a week for hour-long sessions. This kind of survey class would have an average class size of 150 students that varied in major, age, and interest and experience in art history. A class of this size faces the issue of engagement head-on, which is not something that can be resolved by one tool or in a single lesson plan. The plan attached is just one piece of the larger curriculum and needs to be taken as such.

This lesson plan is for a two-week period on the study of Post-Impressionism with specific focus on technique and subjectivity. There are four objectives written out for the lesson plan that would support the larger course objectives. Each week is broken down into two sessions: one for each day the class would meet. Given the vast amount of information to be taught, there remains an aspect of lecture; however, it is always offset by an activity to encourage motivation, engagement, communication, or collaboration. The first instance of incorporating AR/VR takes place during Week 1, Session 2, Activity B in class, where students would be led into The VR Museum of Fine Art within Steam (digital distribution platform for PC gaming) to actually look inside of George Seurat's *Sunday on La Grande Jatte*. Learning formal qualities is crucial to an understanding of art history and virtual reality allows students to explore those elements as never before. Fink (2013) offers a holistic view of active learning that has three components: information, experiences, and reflecting, which I've tried to include in the lesson plan. The lecture components are one method of conveying the information, but students also need to have experiences – like walking through the virtual reality Van Gogh painting – that support student-centered learning. Homework 2 in Week 2 provides an alternative or complement to the typical textbook-based homework in an art history survey class. Incorporating YouTube videos meets students where they are, utilizing technology they are familiar with and enjoy, and is a refreshing change of pace for content delivery. Additionally, the YouTube video highlighting virtual reality shows students that art history is not a dead and irrelevant subject.

I have also included a sample long-term project to demonstrate how AR/VR could be used in a greater capacity, particularly one more in-line with student-centered learning. The project would be comprised of activities done throughout the class that were structured to allow creativity and personal choice. The final project would have metrics for evaluation, but no required vehicle for expressing that knowledge. One potential option for students to choose for that vehicle would be virtual or augmented reality technologies. While the potential of AR and VR technologies as tools of engagement or outlets of creativity is great, they are difficult to easily incorporate into a curriculum. A professor wouldn't want to require a group as large as the survey class to use it for an assignment because the technical aspects might be overwhelming, but if the professor had previously shown AR/VR in the classroom and students found it an engaging method, the ability to choose that technology as a vehicle could motivate student participation.

The sample project could look like this: for each unit, students would pick a work of art containing an element of whatever the subject is (for post-impressionism it could be strong emotions, for realism it could be the ordinary subject matter, etc.) that speaks to them. They would collect these elements throughout the course and, finally, take the various pieces and elements and assemble them to make something new. The only requirements would be that an element from each unit is represented and some kind of communication included – whether a podcast, a written paper, a video, etc. They could create a VR/AR work, a digital work of art, a movie, a painting, whatever – their imagination is the limit. This would allow them to express themselves and show their learning in a more personal way, potentially more meaningful than a traditional final or research paper. Additionally, a long-term project where students are actually creating something and having hands-on interactions supporting active learning gives students the benefit of experiencing what art really is (in terms of making something) and might provide a better understanding or appreciation of the craft, or even empathy towards the artist. AR/VR as the vehicle would offer the additional learning benefits of incorporating modern technologies.

STATEMENT OF BIAS

I come at this topic with two strong biases that underlie my research design. First, I am of the millennial generation that has grown up with information and social media technology in the

classroom and have a strong sense of attachment to using technology at all possible times. I see technology for the gains and the benefits and don't think enough about the negative aspects it can have, perhaps not with the technology itself, but with its application. When I was an art history undergraduate student, my affection/affectation for technology and desire to incorporate it into the classroom had little to do with pedagogical underpinnings and more to do with wanting to participate in, and use, new technology offerings. Research for this project so far has illuminated how crucial it is to incorporate technology into the classroom only when it makes sense and can add something to the content.

Secondly, I have a Bachelor of Arts degree in art history and my experiences in completing that have informed my opinions regarding art history courses and programs at undergraduate universities and colleges everywhere. My experiences from my personal experience at Western Washington University and my time starting a master's degree in art history at George Mason University are indicative of the 'sage on the stage' talking head lecture style format discussed here and those experiences have led to my assumptions that art history programs everywhere are being taught similarly. While my research has shown that there are art history courses and individual professors working to actively change that, I still believe that the majority of programs are using the lecture-style format and slide projectors rather than current or emerging technologies. These beliefs have obviously affected the tone of this research.

DESCRIPTION OF FINAL APPLICATION PROJECT

Current scholarly literature on art history and the use of emerging technologies is sparse and naturally becomes outdated quickly. Much of the research for this project has come from a book dedicated to art history's use of technology, however it was published in 2008 and is largely irrelevant for today. I found few articles addressing virtual reality or augmented reality technologies being used in art history classes and this research exists to fill in that gap. VR and AR technologies are popular within many fields, especially science and medicine, and I came across many uses in other humanities subjects such as language training. The potential for improving learning is clear and art history's stale reputation could benefit from such technologies. The fact that art museums have latched onto these technologies and have

outstanding results makes clear the application is relevant. Excluding barriers such as cost, this research hopes to present a clear argument for why and how art history undergraduate programs should incorporate virtual and augmented realities into the classroom.

ANTICIPATED PROBLEMS/OUTCOMES

A lack of literature specific to this research has been clear from the beginning. Literature on technology in art history is limited and often dated. I have occasionally had to look at more general, but still similar, art programs such as visual arts and art appreciation courses for their uses of reality technologies and consider how they can be applied.

There are obvious fiscal barriers preventing art history undergraduate programs from incorporating reality technologies. Art museums are using tools that aren't always cost-efficient for universities to adopt, particularly for smaller departments and programs such as art history. However, as these technologies become more popular, they are decreasing in cost. A secondary issue is accessibility – some of the tools required to use reality technologies such as tablets or hand-held devices are not ubiquitous; not every college student may have access to such technologies. The training needed to use tools that create and enable virtual or augmented realities is another concern; teachers need to learn how to use the tools themselves and how to use them in a way that makes sense pedagogically. Research may present more problems that are unanticipated at this time.

SUMMARY

Art museums continue to experiment, explore and incorporate virtual and augmented reality technologies in a variety of capacities as a means of facilitating and enhancing visitors' understandings and value of art. They continue to demonstrate the substantial benefits of these technologies in moving the informal pedagogy of art museums away from the static traditional experience that they have traditionally provided and towards an immersive experience that supports learning and long-term knowledge attainment. However, art history as experienced in most classrooms continues to be firmly attached to its traditional pedagogical approach of the sage-on-the-stage (teacher-centric) learning. Rote memorization of names and movements, tired works of art from an outdated canon, and dark halls with clicking slide projectors and droning

voices continue to remind me of my own uninspired personal undergraduate experience studying art history.

Virtual and augmented reality technologies have given new life to art museums and could be used to breathe new life into the art history curriculum. Educators are fortunate to have museums breaking ground for them to follow as well as continued access to the residual products of those museum experiments. The Van Gogh Museum's app Touch Van Gogh was created for the museum in 2014, yet the app is still being updated and is available for download. Educators can incorporate these kinds of tools into the art history classroom to encourage engagement and motivation. Students can immerse themselves in Dali's landscape and feel a sense of control that facilitates a constructivist learning experience. Or students can create augmented reality overlays using a program like Layar, forming new knowledge through active learning. Tools like Layar can get students excited about learning a new technology, while actively producing content that can then be shared through networks in the spirit of connectivism. These types of technologies and tools have the potential to change not only how students learn about art history, but how they perceive the subject as well. The crux is for faculty to focus on creating value for their students, taking the time to learn and develop these new tools, and finding funds to support them.

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POST-IMPRESSIONISM:
TECHNIQUE & SUBJECTIVITY

Art History 200x: Visual Culture in Western Europe in the 19th Century, Fall 2016

OBJECTIVES

1. Explain the development of the Post-Impressionism movement.
2. Using formal analysis, classify works of art provided by the instructor as Post-Impressionist.
3. Compare how Cezanne, Seurat, Van Gogh, and Gauguin treated the notion of subjectivity.
4. Be able to discuss the formal qualities and subjectivity of unknown works of art through verbal presentations and written papers.

WEEK 1

SESSION 1: INTRODUCTION & TECHNIQUE

Lecture topics: The move from Impressionism to Post-Impressionism and an analysis of formal qualities, particularly as it pertains to Post-Impressionist works.

Lecture: Reintroduce elements of formal analysis.
Activity A: In small groups, give students 30 images from all art periods/styles to organize into their own categories. Discuss results as a class.

Lecture: Background history of late 19th century W. Europe, culture, politics, society, etc. and how they contributed to the move from Impressionism to Post-Impressionism.
Activity B: Compare a Monet to a Signac and have students partner to discuss the changes between them, particularly the differences in how formal elements are handled. Discuss results as a class.

Homework 1: Read chapter from the text.
Homework 2: Take 100 images provided by the instructor of art ranging from all periods and styles and perform a large-scale categorization using Pearltrees. Share link with your cohort through Slack and provide explanation of your categories. Be prepared to discuss in class.

SESSION 2: CEZANNE & SEURAT

Lecture topics: The lives and works of Paul Cezanne and Georges Seurat.

Activity A: Review categorization assignment. Instructor will have pulled various collections from Slack sites and as a class, will work through what some of the categories may have been based on [reiterate formal qualities].
Lecture: Introduce both artists and their works, while focusing on the elements they share: structure, order, optics, color (technique).
Activity B: Instructor will take the class on a tour into STEAM - VR Museum of Fine Art to look at Seurat's *Sunday on La Grand Jatte* for a virtual reality exploration into the formal qualities to continue discussing the roles of structure, order, optics, and color. Discuss the role of the element you feel strongest about with a partner.

Homework 1: Readings.
Homework 2: Pick your own work by Cezanne or Seurat and write a personal reflection of how it makes you feel, how the artist might've felt, and how the artist may have wanted you, the viewer, to feel. Share with Slack cohort.

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WEEK 2

SESSION 3: SUBJECTIVITY, VAN GOGH, & GAUGUIN

Lecture topics: The role of emotions, symbolism, and personal experience, plus the lives and works of Van Gogh and Gauguin.

Activity A: Instructor provides a few images by other artists similar in style to Cezanne and Seurat (eg. Signac, Cross, Luce) to small groups and students do formal analyses.
Activity B: In those same small groups, students discuss responses from previous assignment (personal reflections on feelings).
Lecture: Move from Cezanne's and Seurat's emphasis on technique to Van Gogh's and Gauguin's focus on subjectivity.

Homework 1: Readings.
Homework 2: Watch Van Gogh's *Night Cafe* experienced through virtual reality (https://www.youtube.com/watch?v=-0iQSt6mIA4) and write a short written response addressing the formal qualities or handling of subjectivity. Share to Slack cohort.

SESSION 4: RESPOND, TEST, APPLY

Lecture topics: Applying our understanding of technique and subjectivity to interpret and understand works of modern art.

Activity A: Small groups discuss responses from VR video.
Activity B: Class 'quiz' performing formal analyses on works by other Post-Impressionist artists not discussed during class (instructor shows images on screen, students have accompanying paper quiz).
Lecture: Bring in more recent works of art covering modern to post-modern time (the present) and work through how they address formal qualities and subjectivity.

Homework 1: Find a current work of art that reflects some aspect of today's world or your view of the world through either its formal elements of its handling of subjectivity. Share to your Slack cohort with a short explanation of why you chose that particular piece.

LONG-TERM PROJECT

Continuing with the trend throughout this course, please pick one work of art from this unit that contains an element we have discussed that speaks to you. This could be emotion, subjectivity, personal experience, symbolism, light, optics, use of color, or any one of the formal elements. Add this work and particular element to your oeuvre, which you will draw from when creating your final work.

Reminder about the long-term project goals: you will be taking the various works and elements you have collected from each unit and assemble them to make something new. The only requirements will be that an element from each unit is represented and there will need to be some kind of communication included – whether a podcast, a written paper, a video, etc. The final form this project takes is entirely up to the student, although it has to be something they can submit (eg. no performance piece, unless it's recorded).